

## CLAIMS

What is claimed is:

1. A method for use with a plurality of resources integrated within a space for performing a process and a program run by a processor for controlling the process, the method for associating the program with the resources and comprising the steps of:

- 5 identifying at least a first reference point within the space;  
identifying the relative juxtaposition of at least a first resource with respect to the first reference point; and  
associating the first resource with the program as a function of the relative juxtaposition of the resource to the reference point.

2. The method of claim 1 wherein the program includes reference tags, each unique tag referencing a separate resource as one of a program input and a program output, the step of associating including using the relative juxtaposition of the first resource to identify a first of the reference tags to which the first resource is  
5 to be associated and associating the first tag with the first resource.

3. The method of claim 2 wherein the plurality of resources are linked via a communication network, the method further including the step of assigning a logical network address to each of the resources and wherein the step of associating includes identifying the network address of the first resource and correlating the  
5 network address of the first resource with the first tag.

4. The method of claim 3 wherein each resource includes a unique MAC number and wherein the step of assigning a network address to each resource includes, when a resource is linked to the network, obtaining the MAC number from the resource, associating an unused network address with the MAC number,  
5 transmitting the network address to the resource and storing the address at the resource.

5. The method of claim 3 further including the step of replacing each instance of the first tag in the program with the address of the first resource.

6. The method of claim 1 further including the steps of, for each of at least a sub-set of the resources in addition to the first resource:

identifying the relative juxtaposition of the resource with respect to at least one of the reference point and one of the other resources; and

5 associating the resource with the program as a function of the relative juxtaposition of the resource to the at least one of the reference point and one of the other resources.

7. The method of claim 6 wherein the program includes reference tags, each unique tag referencing a separate resource as one of a program input and a program output, the step of associating including, for each resource, using the relative juxtaposition of the resource to identify a reference tags to which the

5 resource is to be associated and associating the tag with the resource.

8. The method of claim 7 further including the step of assigning a logical network address to each of the resources and wherein the associating steps include, for each resource, identifying the network address of the resource and correlating the network address of the resource with the identified tag.

9. The method of claim 8 further including the step of, for each tag, replacing each instance of the tag in the program with the address of the associated resource.

10. The method of claim 8 further including the step of forming a database that correlates tags and associated network addresses.

11. The method of claim 1 wherein the step of identifying the relative juxtaposition includes identifying the locations of at least a sub-set of the plurality of resources and using the location information to determine the relative juxtaposition.

12. The method of claim 11 wherein the step of identifying the locations includes providing an automatic location determining system and using the automatic system to determine the locations of at least a sub-set of the resources.

13. The method of claim 12 wherein the automatic system determines the locations of only a first sub-set of the resources and wherein the step of identifying locations further includes the steps of, for resources in addition to the resources in the first sub-set, identifying locations of the resources manually.

14. The method of claim 13 wherein the program includes reference tags, each unique tag referencing a separate resource as one of a program input and a program output, the method further including the steps of, for each of the resources, determining the relative juxtapositions of the resources and associating each  
5 resource with a separate one of the tags.

15. The method of claim 12 further including the steps of providing an interface and, after the step of automatically determining the locations of the first sub-set of resources, indicating the resources for which locations have to be determined manually via the interface.

16. The method of claim 11 wherein the step of identifying the locations includes providing a separate wireless device for each of at least a sub-set of the resources and at least one sensor within the space, transmitting signals from at least one of the wireless devices and the sensor to the other of the wireless devices and  
5 the sensor and using the signals received by the other of the wireless devices and sensor to determine resource locations.

17. The method of claim 16 wherein the step of providing wireless devices includes providing a separate transmitter for each of the at least a sub-set of the resources and the step of transmitting includes transmitting signals from the transmitters to the at least one sensor.

18. The method of claim 17 wherein the step of providing transmitters includes providing transmitters associated with each of the resources.

19. The method of claim 16 wherein the step of identifying locations also includes, for at least a subset of the plurality of resources, manually measuring the locations of each of at least a sub-set of the resources with respect to at least one of the reference point and at least another of the resources.

20. The method of claim 11 wherein the step of identifying locations includes manually measuring the locations of each of at least a sub-set of the resources with respect to at least one of the reference point and at least another of the resources.

21. The method of claim 11 wherein the step of identifying locations includes providing a wireless information device (WID) and at least one sensor within the space and, for each of at least a sub-set of the resources, positioning the WID proximate the resource, transmitting signals from at least one of the WID and the  
5 sensor to the other of the WID and the sensor, using the signals received by the other of the WID and the sensor to determine WID location and identifying the WID location as the resource location.

22. The method of claim 21 wherein the program includes reference tags, each unique tag referencing a separate resource as one of a program input and a program output, the step of associating including using the relative juxtaposition of the first resource to identify a first of the reference tags to which the first resource is  
5 to be associated and associating the first tag with the first resource the method further including the steps of, for each of at least a sub-set of the resources in addition to the first resource:

identifying the relative juxtaposition of the resource with respect to at least one of the reference point and one of the other resources;

10 using the relative juxtaposition of the resource to identify a reference tag to which the resource is to be associated; and  
associating the identified tag with the resource.

23. The method of claim 2 wherein each of the tags is useable to identify a separate tag specified position and wherein the step of using the relative juxtaposition of the first resource to identify a first of the reference tags includes, for each of at least a sub-set of the tags, identifying the separate tag specified position, comparing the relative juxtaposition information to the tag specified position and, when the relative juxtaposition indicates the tag specified position, identifying the tag associated with the tag specified position.

24. The method of claim 23 wherein each of the tags indicates the tag specified position associated with the tag.

25. The method of claim 23 further including the step of providing an additional information tool that, in conjunction with the tags, is usable to identify the tag specified positions for each of the tags and wherein the step of using the relative juxtaposition further includes the step of using the additional information tool to identify the tag specified position of at least a sub-set of the tags prior to comparing.

26. The method of claim 25 wherein the additional information tool is at least one of a mechanical and an electrical specification.

27. The method of claim 26 wherein the at least one of a mechanical and electrical specification is at least one of a mechanical and electrical schematic diagram.

28. The method of claim 2 wherein the resources are linked via a network, the method further including the step of, prior to associating, assigning a logical network address to each of the reference tags, the step of associating including the steps of identifying the network address of the first tag and assigning the identified address to the first resource.

29. The method of claim 28 wherein the step of assigning the identified address includes storing the identified address at the first resource.

30. The method of claim 28 wherein the step of assigning a network address to each reference tag includes identifying each tag in the program, identifying an unused network address and correlating the unused address with the tag.

31. The method of claim 28 further including the steps of, for each of at least a sub-set of the resources in addition to the first resource, identifying the relative juxtaposition of the resource with respect to at least one of the reference point and one of the other resources, using the relative juxtaposition of the resource  
5 to identify a reference tag to which the resource is to be associated and associating the identified tag with the resource.

32. The method of claim 30 wherein, for each of the tags in addition to the first tag, the step of associating includes identifying the network address of the tag and assigning the identified address to the associated resource.

33. The method of claim 1 further including the step of, after identifying the at least a first reference point, determining the location of the first reference point within the space.

34. The method of claim 1 wherein the at least a first reference point is at the location of at least a second resource.

35. The method of claim 34 wherein the step of identifying the relative juxtaposition between the first and second resources includes determining the location of the second resource.

36. The method of claim 35 wherein the step of identifying the relative juxtaposition further includes determining the orientation of the second resource.

37. The method of claim 1 wherein, after associating, when at least one of the resources is relocated and the reference point is altered, the method further including the step of performing the identifying and associating steps again for at least a sub-set of the resources.

38. The method of claim 1 wherein the step of identifying the relative juxtaposition includes providing a wireless location determining system for determining resource location and using the system to determine the relative juxtaposition.

39. The method of claim 1 wherein the resources include components in an automated manufacturing facility.

40. The method of claim 39 wherein at least a sub-set of the components are programmable logic controllers.

41. The method of claim 1 wherein at least a sub-set of the resources include actuators and sensors.

42. A method for use with a plurality of network linked resources located within a space for performing a process, the method for assigning a network address to at least a first resource to enable communication therewith and comprising the steps of:

- 5 identifying at least a first reference point within the space;
- identifying the relative juxtaposition of the at least a first resource with respect to the at least a first reference point; and
- assigning a first network address to the at least a first resource as a function of the relative juxtaposition of the at least a first resource to the reference point.

43. The method of claim 42 further including the step of providing tags and associated network addresses, each tag useable to identify a separate tag specified position and wherein the step of assigning includes, for each of at least a sub-set of the tags, identifying the separate tag specified position, comparing the relative

5 juxtaposition information to the tag specified position and, when the relative juxtaposition indicates the tag specified position, assigning the address associated with the tag to the at least a first resource.

44. The method of claim 43 wherein the step of providing tags and associated network addresses includes providing at least a first program to be run by at least a first processor to control the resources wherein the program includes at least the first tag and, for each of the tags in the program, assigning an unused
- 5 network address to the tag. .

45. The method of claim 42 wherein the step of identifying the relative juxtaposition includes identifying the relative juxtapositions of each of the plurality of resources.

46. The method of claim 45 wherein the step of assigning includes assigning a separate network address to each of the resources as a function of the relative juxtapositions of the resources.



47. The method of claim 46 wherein the step of identifying the relative juxtapositions includes identifying the locations of the resources and using the location information to determine the relative juxtapositions.

48. The method of claim 42 wherein the reference point is the location of at least one of the resources.

49. A method for use with a plurality of network linked resources located within a space for performing a process, the method for assigning a network address to at least a first resource to enable communication therewith and comprising the steps of:

5 providing a wireless locating system within the space including at least a first sensor;

using the locating system to identify the locations of at least a first sub-set of the resources;

10 manually determining the locations of at least a second sub-set of the resources;

using the resource locations to identifying the relative juxtapositions of at least a sub-set of the resources; and

assigning network addresses to at least a sub-set of the resources as a function of the relative juxtapositions of at least a sub-set of the resources.

50. A method for use with a plurality of network linked resources located within a space for performing a process and a processor running a program to control the process, each resource referenceable on the network by a network address, the program including tags useable to identify tag specified positions of resources within the space, the method for associating network addresses of the

5 resources with program tags and comprising the steps of:

identifying the relative juxtapositions of the resources within the space;

identifying the tag specified positions within the space;

comparing the relative juxtapositions of the resources and the tag specified

10 positions; and

when a relative juxtaposition for a resource indicates a tag specified position associated with a tag, associating the address of the resource and the tag.

51. The method of claim 50 wherein each tag includes the tag specified position.

52. The method of claim 50 further including the step of providing an additional information tool that, in conjunction with the tags, is usable to identify the tag specified positions for each of the tags and wherein the step of identifying the tag specified positions further includes the step of using the additional information tool to

5 identify the tag specified positions.

53. The method of claim 52 wherein the additional information tool is at least one of a mechanical and a electrical specification.

54. A method for use with at least first and second resources to be arranged to perform a process within a space, the method for validating likely correct resource communications and comprising the steps of:

specifying that a first resource communicates with a second resource;

5 identifying the relative juxtapositions of the first and second resources;

determining if the relative juxtapositions of the first and second resources are improbable; and

where, the relative juxtapositions of the first and second resources are improbable, performing a secondary function.

55. The method of claim 54 further including the step of providing a rule set including rules that indicate probable relative resource juxtapositions wherein the step of determining includes determining if the relative juxtapositions of the first and second resources are consistent with the rule set.

56. The method of claim 55 wherein the rule set indicates a maximum distance between the second resource and a reference point within the space such that, when the distance between the reference point and the second resource is greater than the maximum distance, the relative juxtapositions of the first and second  
5 resources are inconsistent with the rule set.

57. The method of claim 56 wherein the reference point is the location of the first resource.

58. The method of claim 55 wherein the secondary function is to indicate that the specified communication is improbable.

59. The method of claim 55 wherein the method is performed in real time as a resource is added to a sub-set of resources to perform the process.

60. The method of claim 55 wherein the method is performed in batch after a sub-set of resources has been configured to perform the process.

61. The method of claim 55 further including the steps of correlating logical network addresses with space locations and wherein the step of identifying the relative positions of the first and second resources includes specifying a network address for each of the first and second resources, determining the locations of the first and second resources from the correlated information and using the first and second resource locations to determine relative positions of the first and second resources.

62. The method of claim 55 wherein the environment includes an automated manufacturing facility.

63. A method for use with at least first and second resources to be arranged to perform a process within an environment, the method for validating likely correct resource communications and comprising the steps of:

specifying a first spatial relationship between first and second resources;

5 determining if the specified spatial relationship between the first and second resources is improbable; and

where, the specified spatial relationship between the first and second resources is improbable, performing a secondary function.

64. The method of claim 59 wherein the environment includes an automated manufacturing facility.

65. A method for use with a plurality of resources to be arranged to perform a process, the method for validating likely correct resource communications and comprising the steps of:

- 5 providing a rule set including rules that indicate probable relative resource positions;
- correlating logical network addresses with environment locations;
- specifying first and second network addresses for a first and a second resources, respectively;
- specifying that the first resource communicates with the second resource;
- 10 identifying the network addresses of the first and second resources;
- using the network addresses of the first and second resources to determine the relative positions of the first and second resources;
- determining if the first and second resource relative positions are consistent with the rule set; and
- 15 where the relative positions of the first and second resources are inconsistent with the rule set, performing a secondary function.

66. The method of claim 65 wherein the rule set indicates a maximum distance between the first and second resources such that, when the distance between the first and second resources is greater than the maximum distance, the relative positions of the first and second resources are inconsistent with the rule set.

67. The method of claim 66 wherein the step of performing a secondary function includes indicating an improbable resource configuration.

68. A method for use with a plurality of resources to be linked via a network within an environment to perform a process and a processor running a program to control the process, the program including at least one of a program input and a program output tag for each of the resources, the method for facilitating association

5 of tags and resources and comprising the steps of:

associating a space within the environment with the process;

providing at least a first information device;

determining the location of the information device within the environment; and

when the information device is proximate at least a sub-space within the

10 space, identifying the resources to be positioned within the sub-space, identifying the tags associated with the resources and indicating the tags associated with the resources.

69. The method of claim 68 further including the steps of, for at least a first of the resources, identifying the resource to the network and indicating one of the tags via the information device that is to be associated with the resource and, wherein, the method further includes the step of associating the identified resource

5 with the indicated tag.

70. The method of claim 69 wherein the step of identifying the resource includes linking the resource to the network.

71. The method of claim 70 wherein the information device includes a display and wherein the step of identifying the tags includes providing a list of the tags and the step of indicating one of the tags includes selecting one of the tags from the list.

72. The method of claim 69 wherein each of the resources is associated with a network address and wherein the step of associating includes determining the resource address and correlating the resource address with the tag.

73. The method of claim 72 wherein the step of 72 wherein the process is repeated for each resource to be located within the sub-space.



74. An apparatus for use with a plurality of resources integrated within a space for performing a process and a program run by a processor for controlling the process, the apparatus for associating the resources with the program and comprising:

- 5 a processor running a program to perform the steps of:
  - identifying at least a first reference point within the space;
  - identifying the relative juxtaposition of at least a first resource with respect to the first reference point; and
  - associating the first resource with the program as a function of the relative
- 10 juxtaposition of the first resource to the reference point.

75. The apparatus of claim 74 wherein the program includes reference tags, each unique tag referencing a separate resource as one of a program input and a program output, the processor associating by using the relative juxtaposition of the first resource to identify a first of the reference tags to which the first resource is
- 15 to be associated and associating the first tag with the first resource.

76. The apparatus of claim 75 wherein the plurality of resources are linked via a communication network, the processor assigning a logical network address to each of the resources and wherein the processor associates by identifying the network address of the first resource and correlating the network address of the first
- 20 resource with the first tag.

77. The apparatus of claim 76 wherein each resource includes a unique MAC number and wherein the processor assigns a network address to each resource by, when a resource is linked to the network, obtaining the MAC number from the resource, associating an unused network address with the MAC number,
- 5 transmitting the network address to the resource and storing the address at the resource.

78. The apparatus of claim 76 wherein the processor is also programmed to replace each instance of the first tag in the program with the address of the first resource.

79. The apparatus of claim 75 wherein the processor is also programmed to, for each of at least a sub-set of the resources in addition to the first resource:

identify the relative juxtaposition of the resource with respect to at least one of the reference point and one of the other resources;

- 5 use the relative juxtaposition of the resource to identify a reference tag to which the resource is to be associated; and  
associate the identified tag with the resource.

80. The apparatus of claim 74 wherein the processor identifies the relative juxtaposition by identifying the locations of at least a sub-set of the plurality of resources and using the location information to determine the relative juxtaposition.

81. The apparatus of claim 75 wherein each of the tags is useable to identify a separate tag specified position and wherein the processor uses the relative juxtaposition of the first resource to identify a first of the reference tags by, for each of at least a sub-set of the tags, identifying the separate tag specified position,

- 5 comparing the relative juxtaposition information to the tag specified position and, when the relative juxtaposition indicates the tag specified position, identifying the tag associated with the tag specified position.

82. The apparatus of claim 75 wherein the resources are linked via a network, the processor also programmed to, prior to associating, assign a logical network address to each of the reference tags, the processor associating by identifying the network address of the first tag and assigning the identified address to

- 5 the first resource.

83. The apparatus of claim 82 wherein the processor assigns a network address to each reference tag by identifying each tag in the program, identifying an unused network address and correlating the unused address with the tag.

84. The apparatus of claim 75 wherein the resources include components in an automated manufacturing facility.

85. The apparatus of claim 75 wherein at least a sub-set of the resources includes actuators and sensors.

86. An apparatus for use with a plurality of network linked resources located within a space for performing a process, the apparatus for assigning a network address to at least a first resource to enable communication therewith and comprising:

- 5 a processor programmed to perform the steps of:
  - identifying at least a first reference point within the space;
  - identifying the relative juxtaposition of the at least a first resource with respect to the at least a first reference point; and
  - assigning a first network address to the at least a first resource as a function
- 10 of the relative juxtaposition of the at least a first resource to the reference point.

87. The apparatus of claim 86 also for use with a processor programmed to control the process, the program including program tags where each tag is associated with a unique network address and useable to identify a separate tag specified position, the processor assigning by, for each of at least a sub-set of the

5 tags, identifying the separate tag specified position, comparing the relative juxtaposition information to the tag specified position and, when the relative juxtaposition indicates the tag specified position, assigning the address associated with the tag to the at least a first resource.

88. The apparatus of claim 86 wherein the processor identifies the relative juxtaposition by identifying the relative juxtapositions of each of the plurality of resources.

89. The apparatus of claim 88 wherein the processor assigns a separate network address to each of the resources as a function of the relative juxtapositions of the resources.

90. An apparatus for use with a plurality of network linked resources located within a space for performing a process and a processor running a program to control the process, each resource referenceable on the network by a network address, the program including tags useable to identify tag specified positions of resources within the space, the apparatus for associating network addresses of the resources with program tags and comprising:

a processor programmed to perform the steps of:

identifying the relative juxtapositions of the resources within the space;

identifying the tag specified positions within the space;

comparing the relative juxtapositions of the resources and the tag specified positions; and

when a relative juxtaposition for a resource indicates a tag specified position associated with a tag, associating the address of the resource and the tag.

91. The apparatus of claim 90 further including a database accessible to the processor and storing additional information tool that, in conjunction with the tags, is usable to identify the tag specified positions for each of the tags, the processor identifying the tag specified positions by using the additional information tool to identify the tag specified positions.

92. The apparatus of claim 91 wherein the additional information tool is at least one of a mechanical and a electrical specification.

93. An associating system for use with a plurality of resources to be linked via a network within an environment to perform a process and a processor running a program to control the process, the program including at least one of a program input and a program output tag for each of the resources, the apparatus for facilitating

5 association of tags and resources and comprising:

at least a first information device;

a processor running a pulse sequencing program to perform the steps of:

associating a space within the environment with the process;

determining the location of the information device within the

10 environment; and

when the information device is proximate at least a sub-space within the space, identifying the resources to be positioned within the sub-space, identifying the tags associated with the resources and indicating the tags associated with the resources.

94. The system of claim 93 wherein the information device includes a display and provides a list of the tags associated with the resources and enables selection of one of the resources and wherein the processor is also programmed to identify a resource when the resource is first linked to the network and to associate a  
5 resource linked to the network with a tag selected contemporaneously therewith via the information device.

95. The system of claim 94 wherein the information device is a wireless information device and the system further includes at least one access point linked to the processor.

96. The system of claim 93 wherein each of the resources is associated with a network address and wherein the processor associates by determining the resource address and correlating the resource address with the tag.

97. The system of claim 96 wherein the processor performs the steps for each resource to be located within the sub-space.